

1 **INFORMATION PROCESSING FOR CREATING A DOCUMENT DIGEST**

2 **FIELD OF INVENTION**

3 The present invention is directed to an information
4 processing apparatus, a server, a method and a program for
5 creating a digest of a document, such as a Web page, the
6 layout of which is predetermined by a creator.

7 **BACKGROUND OF THE INVENTION**

8 A variety of documents are displayed on a display
9 device of a computer. A Web page accessed through the
10 Internet is one of such documents. Incidentally, as types
11 and contents of information submitted through the Internet
12 have been enriched more in recent years, an amount of
13 information per Web page has also been increased more.
14 Consequently, there has occurred a situation where the Web
15 page becomes too large to fit in a display screen of the
16 display device. Such a situation is one occurring also in
17 the case where the aged and persons having weak eyesight
18 zoom the document for the purpose of reading characters
19 displayed on the display device.

20 This situation where the document such as the Web
21 page becomes too large to fit in the display screen causes
22 a plurality of problems described below. First, there
23 occurs a problem that a user is forced to perform a scroll
24 operation. This scroll operation is usually performed by
25 raising or lowering a scroll bar with a mouse, and there-
26 fore, becomes a cumbersome operation for a user. Particu-
27 larly, for an aged person and a user who is not good at
28 adjusting his/her body delicately, the scroll operation is

1 one involving difficulty.

2 Moreover, since it becomes unable to view the whole
3 page at a glance, such problems as below also occur
4 particularly for the aged person: it becomes difficult to
5 grasp the layout of the whole of the page (load on compre-
6 hension); it becomes difficult to find a target section
7 from the whole of the page (load on attention); and it is
8 necessary to remember a content of an upper part of the
9 page when reading a lower part thereof (load on a short-
10 term memory). Today, when our society is aging rapidly,
11 such problems as described above are serious.

12 As a method for solving the problems described above,
13 a method for creating a digest of the document such as the
14 Web page is conceivable, in which a display area of the
15 document is fitted within an area designated by a reader.
16 In this case, it is desirable if not only the display area
17 is merely fitted to the designated area but also areas
18 occupied by respective portions constituting the document
19 can be allocated in accordance with significance thereof to
20 effectively utilize the display area.

21 Heretofore, as this type of technology, there has
22 been a method for creating a digest of the Web page, in
23 which a layout of the Web page is automatically analyzed
24 based on tags of an HTML (refer to Patent Document 1). In
25 this method, the Web page is divided while tracing a tree
26 structure, in which strength of each tag of the HTML is
27 reflected on a hierarchy, from a root thereof to a leaf
28 direction, and the page the digest of which is to be
29 displayed is sorted. Then, contents to be displayed in the
30 respective regions sorted in accordance with significance
31 of the tags of the HTML are decided so as not to delete
32 important information.

33 Moreover, as another conventional technology, there
34 is a method for creating a digest of a Web page based on

1 annotations (refer to Non-Patent Document 1). In this
2 method, locations and significance of regions, which are
3 obtained by external annotations, are utilized. Specifi-
4 cally, the locations of the regions on the digest are
5 decided based on the regions designated by the annotations,
6 and a plurality of regions designated to have high signifi-
7 cance by the annotations are displayed while trying to
8 maintain original area ratios thereof as much as possible.

9 Furthermore, as still another conventional
10 technology, there is a method in which a layout of a
11 plurality of articles are automatically decided (refer to
12 Patent Document 2). In this method, articles are being
13 divided into groups of the articles the numbers of which
14 become smaller step by step with reference to significance
15 of the articles, and display areas for the groups of
16 articles to be displayed are being decided sequentially
17 until all the numbers of articles belonging to the respec-
18 tive groups of articles become one.

19 [Patent Document 1] Gazette of Japanese Patent Laid-
20 Open No. 2001-184344 (pp. 5-6, Fig. 13)

21 [Patent Document 2] Gazette of Japanese Patent Laid-
22 Open No. Hei 9(1997)-330314

23 [Non-Patent Document 1] Maeda and three others,
24 "Digesting Technology for Web Page Based on Annotation,"
25 Technical Research Report (Welfare Information Technology)
26 of The Institute of Electronics, Information and Communica-
27 tion Engineers, 2001, vol. 101, No. 263, pp. 25-30

28 However, in the foregoing digest creation method
29 using the tags of the HTML, the Web page is being divided
30 in accordance with the tree structure in which the layout
31 is reflected, and therefore, information cannot be shared
32 among the regions that have already been branched, and the
33 areas cannot be allocated to the regions optimal for the
34 whole page.

1 In the foregoing digest creation method using the
2 annotations, the areas are allocated to regions in consid-
3 eration of the significance thereof for the whole page.
4 However, in this conventional technology, all of the
5 regions are displayed in order to ensure accesses to
6 digested regions. Therefore, it cannot be said that the
7 limited display area can be effectively utilized, and when
8 the number of regions is large, it is not ensured that the
9 digest fits in the display area required by the reader.

10 Also in the foregoing method in which the layout of
11 the plurality of articles is decided, similarly to the
12 above, the display areas of the articles are decided for
13 the whole of the page in accordance with the significance
14 of the articles. However, in this conventional technology,
15 the articles are grouped and arranged in accordance with
16 the significance thereof, and therefore, this technology
17 cannot be applied to a document the layout of which is
18 predetermined. In addition, in this technology, a
19 relatively few number of articles are assumed, and all of
20 the articles are to be displayed. Accordingly, it becomes
21 impossible to ensure that the articles will be fitted in
22 the area required by the reader when the number of articles
23 becomes larger. Note that, when the total area is forcibly
24 limited, only a small area insufficient for practical use
25 will be allocated to an article the significance of which
26 is low.

27 Hence, it is desirable to realize a system for creat-
28 ing a digest of a document, in which a document, such as a
29 Web page, the layout of which is predetermined by a
30 creator, is transformed to certainly guarantee that the
31 transformed document will fit within a display area
32 required by a reader, and areas are optimally allocated to
33 divided regions so as to make the most of the display area.
34 At this time, it is necessary to ensure accesses to

1 information lost by creating the digest.

2 From this point of view, for example, in the forego-
3 ing digest creation method using the tags of the HTML, when
4 a desired region is designated, the whole content of the
5 region is displayed by detailed content displaying means,
6 and such lost information can be acquired. However,
7 accesses to regions that are not displayed on a digest
8 screen at all cannot be ensured by this method.

9 Moreover, it is desirable to realize a system
10 enabling such browsing as approaching a target portion, in
11 which digests are created also on detail screens, and a
12 range from which information is to be acquired is narrowed
13 step by step while confirming the whole structure of a
14 page. Furthermore, from a viewpoint of providing a more
15 comfortable browsing environment, it is desirable to
16 realize a system for changing displays of digests and
17 detailed contents in response to an operation of a user.

18 **SUMMARY OF THE INVENTION**

19 Therefore, there is now provided systems apparatus
20 and methods providing a technology for creating a digest,
21 in which a document, the layout of which is predetermined
22 by a creator, is transformed to make certain that the
23 transformed document is fitted within a display area
24 required by a reader.

25 Another aspect of the present invention provides a
26 technology enabling such browsing of a document as
27 approaching a target portion, in which a range from which
28 information is to be acquired is narrowed step by step
29 while confirming the whole structure of the document.

30 It is still another aspect of the present invention

1 to provide a more comfortable browsing environment, in
2 which a display content of a digest screen is changed in
3 response to an operation of a user.

4 In order to achieve these aspects, the present inven-
5 tion provides an information processing apparatus for
6 creating a digest of a document the layout of which is
7 determined, the document including a plurality of regions,
8 each region including one or more display elements, the
9 apparatus comprising: means for selecting the display
10 elements based on display priorities of the display
11 elements, and for deciding all of selected display elements
12 as a display content of a digest screen under a condition
13 where a total display area of all of the selected display
14 elements does not exceed a required display area; and means
15 for setting a merging relationship among the regions by
16 deciding a merging region, with which a region not being
17 displayed on the digest screen is merged, from among
18 regions displayed on the digest screen based on layout
19 information for the regions in the document, all of the
20 regions being included in the document.

21 According to the present invention, it can be ascer-
22 tain that the document, such as the Web page, the layout of
23 which is predetermined by the creator is transformed to fit
24 within the display area required by the reader.

25 Furthermore, according to the present invention,
26 because the display content of the digest screen can be
27 changed in response to the operation of the user, a brows-
28 ing environment capable of sensitively coping with a user's
29 wish can be provided.

30 **BRIEF DESCRIPTION OF THE DRAWINGS**

1 The invention and its embodiments will be more fully appre-
2 ciated by reference to the following detailed description
3 of advantageous and illustrative embodiments in accordance
4 with the present invention when taken in conjunction with
5 the accompanying drawings, in which:

6 Fig. 1(a) is a conceptual view showing an example of
7 a configuration of a system realizing a method of the
8 present invention;

9 Fig. 1(b) is a conceptual view showing an example of
10 a configuration of a computer system realizing the method
11 of the present invention;

12 Fig. 2 is a block diagram showing the example of the
13 configuration of the system realizing the method of the
14 present invention;

15 Fig. 3 is a block diagram of portions relating to
16 digest screen display, which are extracted from Fig. 2;

17 Fig. 4 is an overall flowchart showing an example of
18 a method for creating a digest screen;

19 Fig. 5 is a flowchart showing an example of a method
20 for creating a sequence of display elements arrayed in
21 order of display priorities;

22 Fig. 6(a) is a view showing states of the display
23 elements for each region before being sorted in order of
24 the display priorities;

25 Fig. 6(b) is a view showing a sequence of the display
26 elements after being sorted;

27 Fig. 7 is a flowchart showing an example of a method
28 for creating a tree representing a layout of regions;

29 Fig. 8(a) is a view showing a Web page formed of a
30 plurality of the regions;

31 Fig. 8(b) is a tree representing a layout of the
32 regions of the Web page;

33 Fig. 9 is a flowchart showing an example of a method
34 for deciding a display content of the digest screen;

1 Fig. 10 is a flowchart showing an example of a method
2 for setting a merging relationship among the regions;

3 Fig. 11(a) is a view conceptually showing a state of
4 the Web page shown in Fig. 8(a) after visible/invisible
5 regions on the digest screen are fixed;

6 Fig. 11(b) is a view showing an actual appearance of
7 the Web page shown in Fig. 11(a) on a Web browser;

8 Fig. 12(a) is a view showing a state of the tree
9 shown in Fig. 8(b) after the visible/invisible regions on
10 the digest screen are fixed;

11 Fig. 12(b) is a view showing a state of the tree
12 shown in Fig. 12(a) after region IDs of visible nodes are
13 set;

14 Fig. 12(c) is a view showing a state of the tree
15 shown in Fig. 12(b) after region IDs of invisible nodes are
16 set;

17 Fig. 13 is a block diagram of portions relating to
18 detail screen display, which are extracted from Fig. 2;

19 Fig. 14 is an overall flowchart showing an example of
20 a method for displaying a detail screen;

21 Fig. 15 is a flowchart showing an example of a method
22 for creating a digest of the detail screen;

23 Fig. 16 is a block diagram of portions relating to a
24 change of display on the digest screen, which are extracted
25 from Fig. 2;

26 Fig. 17 is an overall flowchart showing an example of
27 a method for changing a display content of the digest
28 screen;

29 Fig. 18 is a flowchart showing an example of a method
30 for changing the display content of the digest screen based
31 on a sequence of display elements added with
32 display/non-display marks;

33 Figs. 19 (a) (b) and (c) give views showing states of
34 sequences of display elements when a specific region is

1 enlarged, Fig. 19(a) is a view showing a state before
2 change;

3 Fig. 19(b) is a view showing a state after the
4 display marks are added;

5 Fig. 19(c) is a view showing a state after the
6 change; and

7 Figs. 20 (a), (b) and (c) show states of the
8 sequences of the display elements when a specific region is
9 reduced: Fig. 20 (a) is a view showing a state before
10 change;

11 Fig. 20(b) is a view showing a state after the
12 non-display marks are added;

13 Fig. 20(c) is a view showing a state after the
14 change.

15 **DETAILED DESCRIPTION OF THE INVENTION**

16 The present invention provides methods, systems and
17 apparatus for providing a technology for creating a digest,
18 in which a document, the layout of which is predetermined
19 by a creator, is transformed to make certain that the
20 transformed document is fitted within a display area
21 required by a reader. At this time, areas are adapted to
22 be optimally allocated to divided regions so as to make the
23 most of the display area, and accesses to information lost
24 by creating the digest of the document are ensured.

25 The present invention also provides a technology
26 enabling such browsing of a document as approaching a
27 target portion, in which a range from which information is
28 to be acquired is narrowed step by step while confirming
29 the whole structure of the document.

30 The present invention further provides a more

1 comfortable browsing environment, in which a display
2 content of a digest screen is changed in response to an
3 operation of a user.

4 The present invention provides an information
5 processing apparatus for creating a digest of a document
6 the layout of which is determined, the document including a
7 plurality of regions, each region including one or more
8 display elements, the apparatus comprising: means for
9 selecting the display elements based on display priorities
10 of the display elements, and for deciding all of selected
11 display elements as a display content of a digest screen
12 under a condition where a total display area of all of the
13 selected display elements does not exceed a required
14 display area; and means for setting a merging relationship
15 among the regions by deciding a merging region, with which
16 a region not being displayed on the digest screen is
17 merged, from among regions displayed on the digest screen
18 based on layout information for the regions in the
19 document, all of the regions being included in the
20 document.

21 Moreover, the information processing apparatus
22 according to the present invention can further comprise
23 means for deciding, as a display content of a detail
24 screen, a region group including the regions displayed on
25 the digest screen and a region merged with the displayed
26 regions in response to that a detail display of the
27 displayed regions is required. Furthermore, this informa-
28 tion processing apparatus can further comprise means for
29 creating control information for controlling a display of
30 the detail screen, and the means for deciding the display
31 content of the detail screen can create a digest of the
32 detail screen based on the control information when the
33 region group is too large to fit in the required display
34 area.

1 Moreover, the information processing apparatus
2 according to another aspect of the present invention can
3 further comprise means for changing the display content of
4 the digest screen based on an operation of a user. Here,
5 the changing means can include means for automatically
6 changing the display content of the digest screen, accompa-
7 nying the operation of the user.

8 Moreover, the present invention provides a server for
9 creating a digest of a document the layout of which is
10 determined, the server transmitting information for creat-
11 ing the digest of the document the layout of which is
12 determined to a client terminal together with the document,
13 the server comprising: means for obtaining display priori-
14 ties of a plurality of display elements belonging to each
15 of regions of the document based on attributes of the
16 display elements; and means for creating layout information
17 for the regions in the document. Furthermore, the means
18 for obtaining the display priorities can further include:
19 means for arraying, for each of the regions, display
20 elements belonging to the regions in accordance with a
21 predetermined criterion; means for obtaining a ratio of a
22 cumulative length of each of the arrayed display elements
23 in each of the regions by dividing the cumulative length by
24 a total length of the region; and means for dividing the
25 ratio of the cumulative length by a significance of the
26 region to which the display element belongs, the ratio
27 having been obtained for each of the display elements.

28 Moreover, the present invention provides a method for
29 creating a digest of a document the layout of which is
30 determined, the document including a plurality of regions,
31 each region including one or more display elements, the
32 method comprising the steps of: selecting the display
33 elements based on display priorities of the display
34 elements, and for deciding all of selected display elements

1 as a display content of a digest screen under a condition
2 where a total display area of all of the display elements
3 does not exceed a required display area; and setting a
4 merging relationship among the regions by deciding a
5 merging region, with which a region not being displayed on
6 the digest screen is merged, from among regions displayed
7 on the digest screen based on layout information for the
8 regions in the document, all of the regions being included
9 in the document.

10 Moreover, the method according to the present inven-
11 tion for creating a digest of a document the layout of
12 which is determined can further comprise the step of decid-
13 ing, as a display content of a detail screen, a region
14 group including the regions of the document displayed on
15 the digest screen and the region merged with the displayed
16 regions in response to that a detail display of the
17 displayed regions is required. Furthermore, this method
18 can further comprise the steps of: creating control infor-
19 mation for controlling a display of the detail screen; and
20 creating a digest of the detail screen based on the control
21 information when the region group is too large to fit in
22 the required display area.

23 Moreover, the method according to another aspect of
24 the present invention for creating a digest of a document
25 the layout of which is determined can further comprise the
26 step of changing the display content of the digest screen
27 based on an operation of a user.

28 Moreover, the present invention provides a program
29 for creating a digest of a document the layout of which is
30 determined, the document including a plurality of regions,
31 each region including one or more display elements, the
32 program allowing a computer to realize: a function to
33 select the display elements based on display priorities of
34 the display elements, and to decide all of selected display

1 elements as a display content of a digest screen under a
2 condition where a total display area of all of the selected
3 display elements does not exceed a required display area;
4 and a function to set a merging relationship among the
5 regions by deciding a merging region, with which a region
6 not being displayed on the digest screen is merged, from
7 among regions displayed on the digest screen based on
8 layout information for the regions in the document, all of
9 the regions being included in the document.

10 Moreover, the program according to the present inven-
11 tion for creating a digest of a document the layout of
12 which is determined can further allow the computer to
13 realize a function to decide, as a display content of a
14 detail screen, a region group including the regions
15 displayed on the digest screen and the region merged with
16 the displayed regions in response to that a detail display
17 of the displayed regions is required. Furthermore, this
18 program can further allow the computer to realize: a
19 function to create control information for controlling a
20 display of the detail screen; and a function to create a
21 digest of the detail screen based on the control informa-
22 tion when the region group is too large to fit in the
23 required display area.

24 Moreover, the program according to another aspect of
25 the present invention for creating a digest of a document
26 the layout of which is determined can further allow the
27 computer to realize a function to change the display
28 content of the digest screen based on an operation of a
29 user.

30 According to the present invention, it can be guaran-
31 teed that the document, such as the Web page, the layout of
32 which is predetermined by the creator is transformed to fit
33 within the display area required by the reader. Accord-
34 ingly, for example, if the display area required by the

1 reader is set at an area of a current window, it is guaran-
2 teed that a scroll operation for browsing the document is
3 not required. Moreover, the display elements of the
4 display content of the digest screen are selected based on
5 the display priorities of the display elements, and there-
6 fore, it is made possible to effectively utilize the
7 limited display area in terms of information acquisition.
8 Furthermore, regions that are not displayed on the digest
9 screen at all are merged with regions partially or entirely
10 displayed on the digest screen, and the merging relation-
11 ship is set between such display areas and such non-display
12 areas. Therefore, accesses to all information lost by
13 creating the digest of the document can be ensured.

14 Moreover, according to the present invention, because
15 the digest is also created for the detail screen, it is
16 made possible to constantly confirm the whole structure of
17 the page, and such browsing as approaching a target portion
18 by narrowing step by step a range from which information is
19 to be acquired is enabled.

20 Furthermore, according to the present invention,
21 because the display content of the digest screen can be
22 changed in response to the operation of the user, a brows-
23 ing environment capable of sensitively coping with a user's
24 wish can be provided. Particularly, when the display
25 content is automatically changed accompanying the operation
26 of the user, for example, when a region for which the user
27 requires a display of a detail content is automatically
28 reduced, a situation is eliminated, where a spot that has
29 been browsed once is undesirably displayed many times, and
30 thus a very comfortable browsing environment for the user
31 is provided.

32 The present invention will be described below in
33 detail based on embodiments shown in the accompanying
34 drawings. However, it is possible to embody the present

1 invention in many different modes, and the present inven-
2 tion should not be interpreted as being limited to descrip-
3 tion contents of the present embodiments. Note that the
4 same reference numerals will be added to the same elements
5 throughout the whole of these embodiments.

6 Although the embodiments below mainly describe a
7 system or a method, the present invention can also be
8 embodied as a program usable by a computer besides the
9 system and the method, as obvious to those skilled in the
10 art. Hence, the present invention can choose an embodiment
11 as hardware, an embodiment as software, or an embodiment as
12 a combination of software and hardware.

13 Fig. 1(a) is a conceptual view showing an example of
14 a configuration of a system, to which a method for creating
15 a digest of a document the layout of which is determined
16 according to the present invention is applied. In this
17 embodiment of the present invention, the information
18 processing apparatus 100 transmits an access request to the
19 proxy server 300 through the Internet in order to acquire
20 desired data from the Web server 200. Preferably, the
21 access request is realized as an HTTP request known to
22 those skilled in the art. The proxy server 300 relays the
23 access request to the Web server 200 through the Internet,
24 and relays response data from the Web server 200 to the
25 information processing apparatus 100 through the Internet.
26 In such a way, the information processing apparatus 100
27 receives the desired response data. The information
28 processing apparatus 100 is a known terminal connectable to
29 the Internet, and is realizable as appropriate by those
30 skilled in the art. It is advantageous to connect the
31 information processing apparatus 100 to the Internet by
32 dial-up and the like through an ISP (Internet Service
33 Provider, not shown). Such a connection of the information
34 processing apparatus 100 to the ISP is not limited to the

1 dial-up, but the connection may be constantly made by use
2 of a dedicated line, ADSL (Asymmetric Digital Subscriber
3 Line), CATV (Cable Television) and the like.

4 In this embodiment of the present invention, the
5 proxy server 300 can be realized by a computer system
6 having a hardware configuration as shown in Fig. 1(b). The
7 computer system includes the central processing unit (CPU)
8 1 and the main memory 4. The CPU 1 and the main memory 4
9 are connected to the hard disk devices 13 and 30 as auxil-
10 iary storage devices through the bus 2. Moreover, remov-
11 able storages (external storage systems having exchangeable
12 recording media) such as the flexible disk device 20, the
13 MO device 28 and the CD-ROM devices 26 and 29 are connected
14 to the bus 2 through the flexible disk controller 19, the
15 IDE controller 25, the SCSI controller 27 and the like,
16 which are associated therewith.

17 The recording media such as a flexible disk, an MO
18 and a CD-ROM are inserted into the removable storages such
19 as the flexible disk device 20, the MO device 28 and the
20 CD-ROM devices 26 and 29, respectively. A code of a
21 computer program for embodying the present invention by
22 giving commands to the CPU and the like in cooperation with
23 an operating system can be recorded in the flexible disk
24 and the like, the hard disk devices 13 and 30 and the ROM
25 14. The computer program is executed by being loaded on
26 the main memory 4. The computer program can be recorded
27 after being compressed. Alternatively, the computer
28 program can be divided into a plurality of pieces, which
29 can be then recorded in a plurality of media.

30 The computer system can further include, as user
31 interface hardware, the pointing device 7 such as a mouse,
32 the keyboard 6, and the display 12 for submitting visual
33 data to a user. Moreover, it is possible to connect the
34 computer system to a printer (not shown) through the

1 parallel port 16 and to a modem (not shown) through the
2 serial port 15. It is possible for the computer system to
3 make a connection to a network through a set of the serial
4 port 15 and the modem, the communication adapter 18 (Ether-
5 net(R) card, token ring card) or the like, and to communi-
6 cate with other computers and the like.

7 The speaker 23 receives, through the amplifier 22, an
8 audio signal subjected to D/A conversion (digital/analog
9 conversion) by the audio controller 21, and outputs the
10 received signal as a sound. Moreover, the audio controller
11 21 subjects audio information received from the microphone
12 24 to A/D conversion (analog/digital conversion), thus
13 making it possible to capture audio information from the
14 outside of the system and put it into the system.

15 From the above description, it will be easily under-
16 stood that the proxy server 300 in this embodiment of the
17 present invention is realized by an information processing
18 apparatus such as a main frame, a workstation, a usual
19 personal computer (PC), a laptop PC, a notebook PC, a
20 palmtop PC, a network computer and a PDA (Personal Data
21 Assistant) or a combination thereof. However, these
22 constituent elements are for illustrative purpose, and all
23 of these constituent elements do not necessarily become
24 essential constituent elements of the present invention.

25 The information processing apparatus 100 and the Web
26 server 200 are also realizable by computer systems having
27 similar hardware configurations. For the Web server, the
28 proxy server and the information processing terminal, which
29 are for use in embodying the present invention, various
30 alterations such as embodying the respective hardware
31 constituent elements thereof by combining a plurality of
32 machines and allocating functions thereto are ones that can
33 easily be assumed by those skilled in the art. Naturally,
34 these alterations are concepts incorporated in the

1 principle of the present invention.

2 It is preferable that each of the proxy server 300
3 and the information processing apparatus 100 and the Web
4 server 200 be installed with software such as an operating
5 system and middleware for making full use of a hardware
6 resource thereof. Preferably, each of the proxy server 300
7 and the Web server 200 is realized by eServer pSeries(R) as
8 a server computer installed with AIX(R) as an operating
9 system provided by International Business Machines Corpora-
10 tion. Moreover, preferably, the information processing
11 apparatus 100 is realized by a personal computer (PC)
12 installed with Windows(R) 2000 as an operating system
13 provided by Microsoft Corporation. In addition, the infor-
14 mation processing apparatus 100 is installed with a Web
15 browser as other software. As such a Web browser, a
16 general Web browser such as Netscape Navigator of Netscape
17 Communications Corporations and Internet Explorer of Micro-
18 soft Corporation is applicable.

19 Fig. 2 is a block diagram showing an example of an
20 information processing system according to the present
21 invention for creating a digest of a document the layout of
22 which is determined. This embodiment is configured such
23 that a Web page is to be processed, and that an information
24 processing apparatus as a client issues a request to the
25 Web server through the proxy server to acquire the Web
26 page. The system of this embodiment comprises: the proxy
27 server including the digest screen display priority infor-
28 mation creating means 40 and the digest screen region
29 layout information creating means 42; and the information
30 processing apparatus including the digest screen display
31 content deciding means 41, the digest screen region merging
32 relationship setting means 43, the detail screen display
33 content deciding means 44, and the control information
34 creating means having the detail screen display priority

1 information creating means 45, the detail screen region
2 layout information creating means 46 and the detail screen
3 region merging relationship setting means 47. Moreover,
4 the digest screen display content deciding means 41
5 includes the digest screen display content changing means
6 48. Note that it is also possible to mount functions
7 provided by the digest screen display priority information
8 creating means 40 and the digest screen region layout
9 information creating means 42, both of which are provided
10 in the proxy server, onto the Web server or the information
11 processing apparatus.

12 The function of the digest screen display priority
13 information creating means 40 is realized by executing a
14 program code recorded in the foregoing storage device such
15 as the hard disk, in which hardware resources such as the
16 storage devices 13 and 30, the central processing unit 1
17 and the main memory 4 are mainly utilized. The digest
18 screen display priority information creating means 40 has
19 functions to obtain display priorities of display elements
20 based on the attributes of the display elements belonging
21 to each region of the Web pages formed of the plurality of
22 regions, and to prepare information concerning the display
23 priorities.

24 Here, the Web page (HTML document) to be inputted is
25 divided into regions of semantic clusters, and is imparted
26 with significance for each of the regions. Note that such
27 division of the regions and impartment of the significance
28 can be realized using a publicly known technology including
29 a method for automatically analyzing the regions based on
30 information in the document, such as HTML tags, a method
31 for manually preparing external annotations, and the like.
32 The display elements of the document belong to any one of
33 the regions, and are units to be controlled whether or not
34 to be displayed. As specific examples of the units to be

1 controlled whether or not to be displayed, portions delim-
2 ited by the HTML tags, or sentences or words are given.

3 In this embodiment, as attributes of the display
4 elements for use when obtaining the display priorities of
5 the display elements, areas of the display elements, emerg-
6 ing positions of the display elements in the regions to
7 which the elements belong and the significance of the
8 regions to which the elements belong are used. However, it
9 is needless to say that the attributes are not limited to
10 these. In such a way, in the event of obtaining the
11 display priorities of the display elements, information
12 intrinsic to the client is not required in principle. A
13 calculation method for the display priorities will be
14 described later.

15 The function of the digest screen display content
16 deciding means 41 is realized by executing a program code
17 recorded in the foregoing storage device such as the hard
18 disk, in which the hardware resources such as the storage
19 devices 13 and 30, the central processing unit 1 and the
20 main memory 4 are mainly utilized. The digest screen
21 display content deciding means 41 has functions to select
22 the display elements based on the display priorities of the
23 display elements, and to decide all of the selected display
24 elements as a display content of the digest screen under
25 the condition where the total display area of all of the
26 selected display elements does not exceed a required
27 display area. Hence, there is a possibility that a region
28 formed only of display elements having low priorities is
29 not displayed on the digest screen at all.

30 The required display area is a display area required
31 directly by a user or indirectly by the information
32 processing apparatus. In this embodiment, the required
33 display area is set to a current window size of the Web
34 browser. Note that, in the description below, this display

1 area is referred to as an "acceptable area" in the meaning
2 that an area for displaying the document must be set within
3 the concerned display area.

4 The function of the digest screen region layout
5 information creating means 42 is realized by executing a
6 program code recorded in the foregoing storage device such
7 as the hard disk, in which the hardware resources such as
8 the storage devices 13 and 30, the central processing unit
9 1 and the main memory 4 are mainly utilized. The digest
10 screen region layout information creating means 42 has a
11 function to create layout information for the regions,
12 which is utilized when setting a merging relationship
13 between a display area and a non-display area on the digest
14 screen. As described above, there is a possibility that a
15 region having low priorities is not displayed on the digest
16 screen at all. Therefore, it is necessary to merge such a
17 non-display region with a display region other than the
18 same in accordance with a predetermined rule for the
19 purpose of ensuring accesses to the non-display region by
20 the user. In this case, which region is displayed or not
21 on the digest screen depends on circumstances of the
22 client, such as a font size desired by the user and a
23 window size of an application for displaying the document.
24 However, the information intrinsic to the client is not
25 required for creating the layout information for the
26 regions. Hence, as described above, the digest screen
27 region layout information creating means 42 can be provided
28 as an independent function of the proxy server. Note that
29 a creation method for the layout information for the
30 regions will be described later.

31 The function of the digest screen region merging
32 relationship setting means 43 is realized by executing a
33 program code recorded in the foregoing storage device such
34 as the hard disk, in which the hardware resources such as

1 the storage devices 13 and 30, the central processing unit
2 1 and the main memory 4 are mainly utilized. The digest
3 screen region merging relationship setting means 43 has a
4 function to decide, after the display content of the digest
5 screen is determined, a merging region, with which the
6 region that is not displayed on the digest screen at all is
7 merged, from among the regions displayed on the digest
8 screen. In this event, the layout information for the
9 regions, which has been created by the digest screen region
10 layout information creating means 42, is utilized. Note
11 that the regions displayed on the digest screen include not
12 only ones all the display elements of which are displayed
13 on the digest screen but also ones part of the display
14 elements of which are displayed on the digest screen.
15 Hereinafter, such regions are referred to as "visible
16 regions," and the regions that are not displayed on the
17 digest screen at all are referred to as "invisible
18 regions." Moreover, in the merging relationship, invisible
19 regions merged with the other regions are referred to as
20 "merged regions," and visible regions that merge the merged
21 regions are referred to as "merging regions." A setting
22 method for the merging relationship will be described
23 later.

24 The function of the detail screen display content
25 deciding means 44 is realized by executing a program code
26 recorded in the foregoing storage device such as the hard
27 disk, in which the hardware resources such as the storage
28 devices 13 and 30, the central processing unit 1 and the
29 main memory 4 are mainly utilized. The detail screen
30 display content deciding means 44 has a function to decide,
31 as a display content of the detail screen, a region group
32 formed of regions displayed on the digest screen and merged
33 regions merged with the displayed regions in response to
34 that a detail display of the displayed regions is required.

1 In this event, the detail screen display content deciding
2 means 44 refers to a merging relationship among the regions
3 set by the digest screen region merging relationship
4 setting means 43. Moreover, when the foregoing group of
5 regions cannot be fitted within the acceptable area, the
6 detail screen display content deciding means 44 selects the
7 display elements based on the display priorities obtained
8 by the detail screen display priority information creating
9 means 45 to be described later, thus creating the digest of
10 the detail screen. In this event, the merging relationship
11 among the regions on the detail screen is set by the detail
12 screen region layout information creating means 46 and the
13 detail screen region merging relationship setting means 47,
14 which are to be described later.

15 The function of the detail screen display priority
16 information creating means 45 is realized by executing a
17 program code recorded in the foregoing storage device such
18 as the hard disk, in which the hardware resources such as
19 the storage devices 13 and 30, the central processing unit
20 1 and the main memory 4 are mainly utilized. The detail
21 screen display priority information creating means 45 has a
22 similar function to that of the digest screen display
23 priority information creating means 40 except that target
24 display elements are different.

25 The function of the detail screen region layout
26 information creating means 46 is realized by executing a
27 program code recorded in the foregoing storage device such
28 as the hard disk, in which the hardware resources such as
29 the storage devices 13 and 30, the central processing unit
30 1 and the main memory 4 are mainly utilized. The detail
31 screen region layout information creating means 46 has a
32 similar function to that of the digest screen region layout
33 information creating means 42 except that target regions
34 are different.

1 The function of the detail screen region merging
2 relationship setting means 47 is realized by executing a
3 program code recorded in the foregoing storage device such
4 as the hard disk, in which the hardware resources such as
5 the storage devices 13 and 30, the central processing unit
6 1 and the main memory 4 are mainly utilized. The detail
7 screen region merging relationship setting means 47 has a
8 similar function to that of the digest screen region
9 merging relationship setting means 43 except that target
10 regions are different.

11 The digest screen display content changing means 48
12 is included in the digest screen display content deciding
13 means 41, and has a function to change the display content
14 of the digest screen based on operations of the user.
15 Here, as the operation of the user, there are operations
16 performed directly for the digest screen and performed
17 indirectly for the detail screen. As an example of the
18 latter one, an operation when closing the detail screen and
19 returning to the digest screen can be given. In this case,
20 the digest screen display content changing means 48 changes
21 an initial one of the digest screen to another one at the
22 timing when the user returns to the digest screen. In
23 addition, the digest screen display content changing means
24 48 can also change the display content of the digest screen
25 automatically, accompanying the operation of the user.

26 As changes of the digest screen, in this embodiment,
27 there are considered five kinds, which are: enlargement of
28 a specific region; reduction of a specific region; deletion
29 of a specific region; display of a specific invisible
30 region; and selection of a specific region. Specific
31 changing methods will be described later.

32 Next, concrete operations of the information process-
33 ing system of the present invention will be described in
34 accordance with a general order when a user browses a Web

1 page.

2 1. Method for creating digest screen

3 Here, a flow of processing from acquiring the Web
4 page from the Web server through the proxy server to creat-
5 ing the digest of the Web page will be described. Fig. 3
6 is a view showing portions relating to the digest screen
7 creation, which are extracted from Fig. 2. As shown in
8 Fig. 3, the digest screen display priority information
9 creating means 40, the digest screen display content decid-
10 ing means 41, the digest screen region layout information
11 creating means 42 and the digest screen region merging
12 relationship setting means 43 relate to the creation of the
13 digest screen.

14 Fig. 4 is an overall flowchart showing an example of
15 the method for creating a digest screen. In Step S10 of
16 Fig. 4, the digest screen display priority information
17 creating means 40 obtains the display priorities of all of
18 the display elements of the Web page, and creates a
19 sequence of the display elements arrayed in order of the
20 display priorities thereof. Next, in Step S12, the digest
21 screen region layout information creating means 42 creates
22 layout information for the regions of the Web page. Next,
23 in Step S14, the digest screen display content deciding
24 means 41 decides the display content of the digest screen
25 based on the acceptable area and the sequence of the
26 display elements received from the digest screen display
27 priority information creating means 40. Finally, in Step
28 S16, the digest screen region merging relationship setting
29 means 43 sets the merging relationship between the display
30 area and the non-display area on the digest screen based on
31 the layout information for the regions, which is received
32 from the digest screen region layout information creating

1 means 42. Here, there are no limitations on an execution
2 order of the processing's performed in Steps S10 and S12,
3 and therefore, the processing in Step S12 can be performed
4 before the processing in Step S10.

5 Note that two processings described below as preproc-
6 essings shall be provided for the Web page (HTML document)
7 before the processings in Steps S10 and S12. One is
8 processing for scanning a tree structure (DOM tree) made
9 from the Web page and embedding therein tags as
10 direct parents of texts, images and the like displayed on
11 the Web browser. Thus, it is made possible to uniformly
12 treat processings for contents such as the texts and the
13 images as processing for the tags. The "display
14 element" referred to in this embodiment shall mean one
15 formed by combining each of the texts, images and the like
16 with the tag as the direct parent thereof. Note
17 that, in the general Web browser, there is no change on the
18 appearance of the Web page even if such processing is
19 provided. Another processing is processing for dividing a
20 text into pieces with a suitable length by using, as hints,
21 punctuation marks including commas and periods, segments of
22 words and the like. Each of the divided texts has the
23 tag as its parent, and becomes a display element.
24 Note that in the case of performing such processings,
25 regional information intrinsic to the Web page, that is,
26 the locations and significance of the respective regions
27 are referred to. Typically, this information is stored as
28 a file of an XML format, and the locations and significance
29 of the respective regions are expressed as attributes of
30 XML tags. XPath's can be utilized for designating the
31 locations of the regions on the original Web page. Moreo-
32 ver, the significance are indicated by real numbers of 0 or
33 more.

34 Next, an operation of creating the sequence of the

1 display elements arrayed in order of the display priorities
2 thereof, which is performed by the digest screen display
3 priority information creating means 40, will be concretely
4 described with reference to the flowchart of Fig. 5 and the
5 explanatory state view of Fig. 6. In Step S20 of Fig. 5,
6 the digest screen display priority information creating
7 means 40 arrays, for each of the regions of the Web page,
8 the display elements belonging thereto in accordance with a
9 predetermined criterion. In principle, the display priori-
10 ties are put in this array order. Hence, as the predeter-
11 mined criterion, for example, the sequence where the
12 display elements emerge on the Web page is conceivable.
13 According to the criterion, when only a part of a region is
14 displayed on the digest screen, display elements belonging
15 to the region will be sequentially selected in order from a
16 head thereof without skipping any one of the following
17 elements, and the selected display elements will be
18 displayed on the digest screen. Moreover, as other crite-
19 ria, HTML tags and attributes of the tags, which are ances-
20 tors of the respective display elements in the DOM tree,
21 are conceivable. Furthermore, when the display elements
22 are texts, the display elements can be weighted based on
23 whether the texts contain a particular keyword. In the
24 case of using these criteria, when a part of the regions is
25 displayed on the digest screen, a "large text," a "colored
26 text," a "text containing an important keyword" and the
27 like will be displayed on the digest screen preferentially.

28 Next, in order to grasp the display area on the Web
29 browser, a "cumulative length" of each of the display
30 elements is obtained (Step S22). An example of the
31 "length" is the number of characters of the text. Also for
32 the image, if possible, a "length" compatible with that of
33 the text is obtained by use of a "width attribute" and a
34 "height attribute." When these attributes cannot be used,

1 it is assumed that the image has a predetermined "length."
2 Specifically, for example, a constant is established such
3 that "the image is regarded to have a width of 200 pixels
4 and a height of 200 pixels," and the established constant
5 is converted into the "length" of the text. The display
6 elements are arrayed for each of the regions as determined
7 in Step S20, and "cumulative lengths" of the respective
8 regions to each thereof are obtained. For example, if four
9 display elements in a certain region has "lengths" of 10,
10 5, 20 and 15 in order, the "cumulative lengths" become 10,
11 15, 35 and 50, respectively. Moreover, the "length" of the
12 whole region is also obtained (Step S24). This is obtained
13 by defining the "cumulative length" of the last element in
14 the region as the "length" of the whole region. Next,
15 "ratios of the cumulative lengths" of the respective
16 display elements in the region are obtained (Step S26).
17 The "ratios of the cumulative lengths" are obtained by
18 dividing the "cumulative lengths" of the display elements
19 by the "length" of the whole region for each thereof.
20 Hence, the "ratio of the cumulative length" of the last
21 display element in the region always becomes 1, and the
22 display elements other than the last one take values larger
23 than 0 and smaller than 1.

24 Finally, the display priorities of the display
25 elements are obtained, the display elements are sorted on
26 the whole of the Web page in order of the display priori-
27 ties, and the sequence of the display elements arrayed in
28 order of the display priorities are created (Step S28).
29 Here, the display priorities are obtained by dividing the
30 "ratios of the cumulative lengths" of the respective
31 display elements obtained in Step S26 by the "significance"
32 of the region to which the display elements belong for each
33 thereof (however, this processing is not performed for the
34 region the "significance" of which is 0, and the region

1 shall forcibly be set as an "invisible region"). Hence,
2 the smaller the values of the display priorities are, the
3 higher the priorities the display priorities indicate. The
4 above processing will be described with reference to the
5 explanatory state view of Fig. 6. Fig. 6(a) shows states
6 of the display elements for each of the regions before
7 sorted. In Fig. 6(a), the rectangles indicate regions, and
8 the squares and the circles indicate display elements
9 belonging to the regions. In the illustrated example, the
10 Web page is formed of three regions, which are the regions
11 50, 51 and 52, and these regions have significance of 0.9,
12 0.5 and 0.1, respectively. Region numbers added in emerg-
13 ing order on the Web page are given to the respective
14 regions. Here, the region numbers 1, 2 and 3 are given to
15 the regions 50, 51 and 52, respectively. Moreover, the
16 predetermined criterion for arraying the display elements
17 is an emerging order thereof in each of the regions here.
18 With regard to the numbers written in each of the display
19 elements, the numbers on the upper row indicate the forego-
20 ing region number and an emerging order in the region
21 ("x-y" denotes a y-th display element in a region of a
22 region number x), the number on the middle row indicates a
23 "ratio of the cumulative length," and the number on the
24 lower row indicates a "display priority." In this process-
25 ing, a blank or a bullet of an itemized text is not treated
26 as a single display element but treated as one unified with
27 the next display element. In Fig. 6(a), the first, third
28 and fifth display elements in the region of the region
29 number 2 correspond to such unified elements, and are
30 represented by circles. Then, when sorting these display
31 elements in ascending order of the display priorities, the
32 display elements turn into the state shown in Fig. 6(b).
33 Note that the display priorities of the display elements
34 such as bullets are not considered.

1 Next, an operation of creating the layout information
2 for the regions, which is performed by the digest screen
3 region layout information creating means 42, will be
4 concretely described with reference to the flowchart of
5 Fig. 7 and the explanatory correspondence relationship view
6 of Fig. 8. First, a Web page to be processed is shown in
7 Fig. 8(a). In the illustrated example, two tables are made
8 by <TABLE> tags, and one table is nested in the other. The
9 outside table is drawn by the alternate long and short
10 dashed lines, and has three cells in the longitudinal
11 direction. The inside of the center cell further has a
12 table. This inside table is drawn by the dotted lines, and
13 has four cells in the lateral direction. Each cell
14 includes one or more regions, and each region is repre-
15 sented by a rectangle. The numbers written in the rectan-
16 gles indicate region numbers. As described above, in the
17 HTML document, layouting in which the document is aligned
18 longitudinally and laterally is realized by the structure
19 of the table, which is made by the <TABLE> tags. The tree
20 showing the layout of the regions on the Web pages is shown
21 in Fig. 8(b). In Fig. 8(b), leaves represented by the
22 squares correspond to the regions, and numbers written in
23 the squares indicate the region numbers of the regions
24 corresponding thereto. Moreover, nodes represented by the
25 circles correspond to cells or tables. This tree shown in
26 Fig. 8(b) is the layout information for the regions. A
27 method for creating the tree shown in Fig. 8(b) will be
28 concretely described below.

29 In Step S30 of Fig. 7, upon receiving the Web page
30 shown in Fig. 8(a), the digest screen region layout infor-
31 mation creating means 42 creates a tree structure having
32 HTML tags as nodes. Next, in this tree structure, portions
33 that indicate the regions are defined as leaves, and the
34 table that houses the regions (which is indicted by the

1 <TABLE> tags) and cells in the table (which are indicated
2 by <TD> tags and <TH> tags) are defined as intermediate
3 nodes (Step S32). In this case, a group of regions located
4 outside the outermost table is also adapted to form an
5 intermediate node that merges adjacent regions into one.
6 Thereafter, residual nodes are deleted to roll forward the
7 intermediate nodes and the leaves, and then, the tree shown
8 in Fig. 8(b) is finally created (Step S34). Note that,
9 when the digest screen region layout information creating
10 means 42 is provided as a function of a proxy server, the
11 tree showing the layout among the regions can be easily
12 transmitted to a client by being represented as a text such
13 as, for example, ((1, 2, 3), ((4, 5), 6, 7, 8), (9, 10)).

14 Next, an operation of deciding the display content of
15 the digest screen, which is performed by the digest screen
16 display content deciding means 41, will be described with
17 reference to the flowchart of Fig. 9. In Step S40 of Fig.
18 9, first, 1 is assigned to the variable i. Here, i
19 indicates an order of the display elements in the sequence
20 of the display elements arrayed in order of the display
21 priorities. Specifically, the variable i that is equal to
22 1 (i = 1) indicates the first display element in the
23 sequence of the display elements. Next, in Step S42, it is
24 determined whether or not an i-th display element exists.
25 This determination is one for determining whether or not
26 examination has been made throughout all of the display
27 elements in the sequence thereof. Hence, when the i-th
28 display element does not exist, the processing is termi-
29 nated. When the i-th display element exists, the process-
30 ing proceeds to Step S44, where it is determined whether or
31 not the display content is fitted within the acceptable
32 area even if the i-th display element is displayed. When
33 the content is not fitted, the processing is terminated.
34 When the content is fitted, the processing proceeds to Step

1 S46, where the i-th display element is displayed, and the
2 value of the variable i is incremented by 1. Thereafter,
3 the processing returns to Step S42, from which a series of
4 the processing is repeated. The display is controlled
5 within a range where the whole of the display content does
6 not exceed the acceptable area in such a manner as
7 described above, thus making it possible to create a
8 desired digest.

9 Note that, though a certain display element cannot be
10 displayed because the area thereof exceeds the acceptable
11 area depending on the layout of the Web page to be
12 processed, in some cases, a display element the display
13 priority of which is lower than that of the certain display
14 element (located in a latter sequence of the display
15 elements) can be displayed. In order to display such a
16 display element, a configuration may be adopted, in which
17 all of the display elements in the sequence thereof are
18 examined from the head, and all of the elements capable of
19 being displayed are displayed. With such a configuration,
20 the number of display elements on the digest screen will be
21 increased, and more information can be displayed. On the
22 other hand, there is also a possibility that such a
23 configuration will lead to such a display in which the
24 contents of the original Web page are partially omitted,
25 resulting in a difficulty in semantically understanding the
26 page.

27 Next, an operation of setting the merging relation-
28 ship between the visible regions and the invisible regions
29 on the digest screen, which is performed by the digest
30 screen region merging relationship setting means 43, will
31 be concretely described with reference to the flowchart of
32 Fig. 10 and the explanatory state views of Figs. 11 and 12.

33 First, the state of a Web page after firmly setting
34 the visible regions and the invisible regions on the digest

1 screen is shown in Fig. 11(a). Note that the Web page
2 shown in Fig. 11(a) is the same one as the Web page shown
3 in Fig. 8(a), and the numbers written in the rectangles
4 indicate the region numbers. In the illustrated example,
5 four regions the region numbers of which are 1, 3, 5 and 7
6 are decided as the visible regions, and the invisible
7 regions are diagonally shaded. Note that Fig. 11(a) is a
8 conceptual view for explanation, and on an actual browser,
9 for example, such a digest as shown in Fig. 11(b) is
10 displayed.

11 Fig. 12(a) shows a tree representing the layout of
12 the regions corresponding to those of Fig. 11(a).
13 Similarly, leaves corresponding to the invisible regions
14 are diagonally shaded. Moreover, the numbers written in
15 the squares indicate the region numbers of the regions
16 corresponding thereto. From the tree shown in Fig. 12(a)
17 as a start point, the merging relationship between the
18 visible regions and the invisible regions is set. Note
19 that, hereinafter, such an intermediate node including one
20 or more visible regions as descendants is referred to as a
21 "visible node," and such an intermediate node the descen-
22 dant regions of which are all invisible regions is referred
23 to as an "invisible region." In addition, nodes having the
24 same parent node are referred to as "sibling nodes," and in
25 the sibling nodes, one located upward or leftward on the
26 corresponding Web browser is referred to as an "older
27 sibling node," and one located downward and rightward
28 thereon is referred to as a "younger sibling node." In the
29 three trees shown in Fig. 12, the nodes drawn on the left
30 are shown as older sibling nodes. A method for setting the
31 merging relationship will be concretely described below.

32 In Step S50 of Fig. 10, upon receiving the tree
33 created by the digest screen region layout information
34 creating means 42, the digest screen region merging

1 relationship setting means 43 sets region IDs for the nodes
2 as leaves. Here, for the region IDs set for the leaf
3 nodes, the region numbers of the regions corresponding
4 thereto shall be set.

5 Next, in Step S52, the region IDs are set for all of
6 the visible nodes while tracing the tree in a bottom-up
7 manner. Here, the region ID set for a visible node shall
8 be set the same as a region ID of a child of the visible
9 node, which is located in the most upper-left position on
10 the corresponding Web page, the child being selected from
11 nodes partially or entirely displayed. Note that, when a
12 plurality of regions applicable to the foregoing condition
13 are present, a region having a higher significance shall be
14 employed. A state where the foregoing processing has been
15 performed for the tree shown in Fig. 12(a) is shown in Fig.
16 12(b). Referring to Fig. 12(b), for the visible nodes 60
17 and 61, the region IDs of the child regions located
18 leftward are selected and set in accordance with the
19 foregoing condition. For the visible node 63, there is
20 only one child node partially or entirely displayed, and
21 therefore, the region ID of the concerned node is directly
22 set therefor.

23 Next, in Step S54, the region IDs are set for all of
24 the invisible nodes while tracing the tree in a top-down
25 manner. Here, with regard to the region ID set for an
26 invisible node, if there are visible nodes in the older
27 sibling nodes of the invisible node, the region ID shall be
28 set the same as that of the closest node thereamong, and if
29 there are no visible nodes in the older sibling nodes, the
30 region ID shall be set the same as that of the closest node
31 among younger sibling nodes. Moreover, also for intermedi-
32 ate nodes of descendants of the concerned invisible node,
33 the same region IDs are set. Note that attention shall be
34 paid to that, in the first invisible nodes in the

1 respective branches in the case of tracing the tree in a
2 top-down manner, at least one of the visible node or the
3 sibling node as a visible region is present. A state where
4 the foregoing processing has been performed for the tree
5 shown in Fig. 12(b) is shown in Fig. 12(c). Referring to
6 Fig. 12(c), the same region ID as that of the visible node
7 61 is set for the invisible node 62.

8 Finally, in Step S56, based on the tree in which the
9 region IDs are set for all of the intermediate nodes,
10 merging regions that merge the invisible regions therewith
11 are decided for all of the invisible regions in the tree,
12 and the processing is terminated. Here, each of the
13 merging regions that merge the invisible regions therewith
14 shall be a region identified by the region ID of the
15 closest one of the visible nodes or the visible regions of
16 the older sibling nodes if there are such nodes and
17 regions. Moreover, if there are no visible nodes or
18 visible regions in the older sibling nodes, and if there
19 are visible nodes or visible regions in the younger sibling
20 nodes, the merging region shall be a region identified by
21 the region ID of the closest one thereamong. Furthermore,
22 if there are no visible nodes or visible regions in the
23 older or younger sibling nodes, the merging region shall be
24 a region identified by the region ID of the parent node. A
25 result of performing the foregoing processing based on the
26 tree shown in Fig. 12(c) is shown below.

27

Table 1

28

Invisible regions

Visible regions

29

(merged regions)

(merging regions)

30

2

1

31

4

5

32

6

5

33

8

7

1	9	5
2	10	5

3 Here, the numbers indicate the region numbers (region
4 IDs). The region numbers written on the left side are the
5 region numbers of the invisible regions, that is, of the
6 merged regions. Then, the region numbers written on the
7 right side are the region numbers of the visible regions
8 that merge the foregoing invisible regions therewith.
9 Here, all of the regions indicated by the region numbers 4,
10 6, 9 and 10 are merged with the visible region of the
11 region number 5. As understood from this, there are no
12 limitations on the number of regions to be merged by the
13 visible regions. The merging relationship between the
14 visible regions and the invisible regions on the digest
15 screen is set in such a manner as described above, thus
16 making it possible to ensure accesses to the regions lost
17 by creating the digest.

18 2. Method for displaying detail screen of digest

19 Here, a flow of processing to displaying a detail
20 screen in response to a request for a detail display by a
21 user, which is made in order to access information that is
22 not displayed on the digest screen, will be described.
23 Fig. 13 is a view showing portions relating to the detail
24 screen display of the digest, which are extracted from Fig.
25 2. As shown in Fig. 13, the digest screen region merging
26 relationship setting means 43, the detail screen display
27 content deciding means 44, the detail screen display prior-
28 ity information creating means 45, the detail screen region
29 layout information creating means 46 and the detail screen
30 region merging relationship setting means 47 relate to the
31 detail screen display of the digest.

1 Fig. 14 is an overall flowchart showing an example of
2 the method for displaying the detail screen of the digest.
3 In Step S60 of Fig. 14, the detail screen display content
4 deciding means 44 decides a display content of the detail
5 screen based on the merging relationship among set regions
6 in response to a request for a detail display of the
7 regions to be displayed on the digest screen. Next, in
8 Step S62, it is determined whether or not the decided
9 display content of the detail screen is fitted in the
10 acceptable area. When the display content is fitted in the
11 acceptable area, the processing is terminated there. When
12 the display content is not fitted in the acceptable area,
13 the processing proceeds to Step S64, where the digest of
14 the detail screen is created, and the processing is
15 terminated.

16 Regions to be decided as the display content of the
17 detail screen in Step S60 of Fig. 14 include not only
18 visible regions explicitly designated by a user but also
19 invisible regions to be merged with the visible regions as
20 the merging regions. Thus, it is made possible for the
21 user to access information that has not been displayed on
22 the digest screen. Relationships between the designated
23 areas and the regions to be actually displayed on the
24 detail screen in the case of following the merging
25 relationship shown in Table 1 will be shown below.

26	Designated region	Display region
27	1	1, 2
28	3	3
29	5	4, 5, 6, 9, 10
30	7	7, 8

31 Here, the numbers indicate the region numbers (region
32 IDs). The region numbers written on the left side are the

1 region numbers of the designated regions. Moreover, the
2 region numbers written on the right side so as to corre-
3 spond to the region numbers of the designated regions are
4 the region numbers of the regions to be actually displayed
5 on the detail screen. According to this, for example, when
6 the user designates the region of the region number 1 and
7 requires the detail screen, the regions of the region
8 numbers 1 and 2 will be displayed. Hereinafter, a group of
9 the regions to be decided as the display content of the
10 detail screen will be referred to as "detail display target
11 regions" or simply "target regions."

12 When the whole of the detail display target regions
13 are fitted in the acceptable area, the detail display
14 target regions may be directly displayed, thus causing no
15 problem. However, there is a possibility that the whole of
16 the detail display target regions are too large to be
17 fitted in the acceptable area, depending on the merging
18 relationship among the regions on the digest screen. In
19 this case, in the information processing apparatus accord-
20 ing to the present invention, a digest is also created for
21 the detail screen, thus making it possible for the user to
22 sequentially narrow a range from which information is
23 obtained and to approach a target portion while confirming
24 the whole structure of the document. A method for creating
25 the digest of the detail screen will be concretely
26 described below.

27 Fig. 15 is a flowchart showing an example of the
28 method for creating the digest of the detail screen. In
29 Step S70 of Fig. 15, the detail screen display priority
30 information creating means 45 obtains display priorities
31 for display elements included in the target regions, and
32 creates a sequence of the display elements arrayed in order
33 of the display priorities. Moreover, in Step S72, the
34 detail screen region layout information creating means 46

1 creates layout information for the target regions. Note
2 that, also here, the processing in Step S72 may be
3 performed prior to the processing in Step S70. Next, in
4 Step S74, the detail screen display content deciding means
5 44 decides the display content of the detail screen based
6 on the sequence of the display elements, which is created
7 by the detail screen display priority information creating
8 means 45. After the display content of the detail screen
9 is fixed, in Step S76, the detail screen region merging
10 relationship setting means 47 sets the merging relationship
11 among the target regions on the detail screen by use of the
12 layout information for the target regions, which is created
13 by the detail screen region layout information creating
14 means 46. Then, the processing is terminated.

15 Here, the processing performed in each step of Fig.
16 15 is basically the same as the processing described in "1.
17 Method for displaying digest screen." However, while all
18 of the regions of the Web page and all of the display
19 elements are targets to be processed in the creation of the
20 digest of the Web page, the detail display target regions
21 and the display elements included therein are set to be
22 targets to be processed in the creation of the digest of
23 the detail screen. Moreover, in the case of obtaining
24 display priorities of the display elements included in the
25 detail display target regions, it is desirable to preferen-
26 tially gather the first display elements of the respective
27 regions of the detail display target regions to a head of
28 the sequence of the display elements from a viewpoint of
29 ensuring the accesses to the regions that have been invis-
30 ible on the digest screen as much as possible.

31 As obvious from the foregoing description, the
32 processing for creating the digest of the detail screen can
33 be repeatedly performed until the detail display target
34 regions finally become one. Note that, when the whole of

1 the detail display target regions are too large to be
2 fitted in the acceptable area, it is also possible to
3 display detailed contents in normal display order and to
4 delimit the detailed contents so as to be fitted in the
5 acceptable area for display, as in use of the "more"
6 command in the UNIX(R) operating system. Hence, in the
7 digest creation method for the detail screen, when the
8 detail display target regions are still too large to be
9 fitted within the acceptable area though the regions
10 finally become one, the detailed contents can be displayed
11 in normal display order and can be delimited so as to be
12 fitted in the acceptable area for display.

13 3. Method for changing display content of digest 14 screen

15 A processing flow to changing the display content of
16 the digest screen in response to the operation of the user
17 in order to provide a more comfortable browsing environment
18 will be described. Fig. 16 is a view showing portions
19 relating to the change of the display content of the digest
20 screen, which are extracted from Fig. 2. As shown in Fig.
21 16, the digest screen display content changing means 48
22 included in the digest screen display content deciding
23 means 41, and the digest screen region merging relationship
24 setting means 43 relate to the change of the display
25 content of the digest screen.

26 Fig. 17 is an overall flowchart showing an example of
27 the method for changing the display content of the digest
28 screen. In S80 of Fig. 17, the digest screen display
29 content changing means 48 adds "display marks" or
30 "non-display marks" to the display elements as elements in
31 the sequence of the display elements arrayed in order of
32 the display priorities in accordance with the operation of

1 the user. Here, the "display marks" shall be added to
2 display elements desired to be preferentially displayed,
3 and the "non-display marks" shall be added to display
4 elements that are not desired to be displayed. Which mark
5 will be added to which element depends on the operation
6 content of the user. Next, in Step S82, the display
7 content of the digest screen is changed based on the
8 acceptable area and the sequence of the display elements
9 added with the "display marks"/"non-display marks." Next,
10 in Step S84, in response to that new visible and invisible
11 regions have been firmly set on the digest screen, the
12 digest screen region merging relationship setting means 43
13 sets a new merging relationship between the visible regions
14 and the invisible regions on the digest screen. Then, the
15 processing is terminated.

16 Here, it is assumed that the operation of the user is
17 converted into control information in accordance with a
18 predetermined operation rule. As described above, in this
19 embodiment, the converted information is any of enlargement
20 of a specific region, reduction of a specific region,
21 deletion of a specific region, display of a specific
22 invisible region, and selection of a specific region.
23 Moreover, the predetermined operation rule is information
24 indicating a correspondence relationship between a physical
25 operation (click, key press and the like) of the user and
26 the change content of the digest screen. For example, the
27 information is that "when a specific portion of a detail
28 screen in a certain region is clicked, the concerned detail
29 screen is deleted, and a region corresponding thereto on
30 the digest screen is reduced," and the like. In this
31 embodiment, the predetermined operation rule shall be sent
32 from the proxy server with the Web page.

33 Fig. 18 is a flowchart showing the processing of Step
34 S82 in Fig. 17 in more detail. In Step S90 of Fig. 18, the

1 digest screen display content changing means 48 displays
2 all of the display elements added with the "display marks"
3 in the sequence of the display elements. Note that, when a
4 large number of display elements added with the display
5 marks exist, there is also a possibility that all of the
6 display elements cannot be displayed within the acceptable
7 area. Whether or not the display elements are allowed to
8 exceed the acceptable area in such a case, and which
9 display element will be selected when the display elements
10 are not allowed to exceed the acceptable area, shall be
11 predetermined as a rule. For example, display elements
12 having higher display priorities will be selected when the
13 display elements are not allowed to exceed the acceptable
14 area.

15 Next, in Step S92, it is determined whether or not
16 there is room for further displaying other display elements
17 in the acceptable area. When there is no room, the
18 processing is terminated. When there is room, the process-
19 ing proceeds to Step S94, where 1 is assigned to the
20 variable i. Here, i indicates an order of the display
21 elements in the sequence of the display elements arrayed in
22 order of the display priorities. Specifically, the
23 variable i that is equal to 1 ($i = 1$) indicates the first
24 display element in the sequence of the display elements.
25 Next, in Step S96, it is determined whether or not an i-th
26 display element exists. This determination is one for
27 determining whether or not examination has been made
28 throughout all of the display elements in the sequence
29 thereof. Hence, when the i-th display element does not
30 exist, the processing is terminated. When the i-th display
31 element exists, the processing proceeds to Step S98, where
32 it is examined whether or not the display mark/non-display
33 mark is added to the i-th display element. When any of the
34 marks is added to the i-th display element, the processing

1 proceeds to Step S104. This is because the display element
2 added with the mark does not require any more processing in
3 any case for the reasons that a display element has already
4 been displayed in Step S90 when the display element is
5 added with the display mark and that a display element is
6 not displayed when the display element is added with the
7 non-display mark. When the i-th display element is not
8 added with any of the marks, the processing proceeds to
9 Step S100. In Step S100, it is determined whether or not
10 the display elements are fitted within the acceptable area
11 even if the i-th display element is displayed in addition
12 to the current display content. When the display content
13 added with the i-th display element is not fitted, the
14 processing is terminated. When the display content is
15 fitted, the processing proceeds to Step S102, where the
16 i-th display element is displayed. When it is determined
17 that the i-th display element is added with any of the
18 marks in S98, or after the processing proceeds from Step
19 S102 to Step S104, where the value of the variable i is
20 incremented by 1, the processing returns to Step S96, from
21 which a series of the processing is repeated.

22 Note that, even if the i-th display element is deter-
23 mined not to be fitted to the acceptable area in Step S100,
24 there is a case described below depending on the layout of
25 the Web page to be processed. Specifically, there is a
26 case where, though the i-th display element cannot be
27 displayed because the area thereof exceeds the determined
28 area, a display element the display priority of which is
29 lower than that of the i-th display element (located in the
30 latter sequence of the display elements) can be displayed.
31 Hence, such a display element may be adapted to be
32 displayed. For this purpose, it is only necessary that the
33 processing proceeds to Step S104 without termination when
34 the foregoing determination is "not fitted." The method

1 for changing the display content of the digest screen will
2 be concretely described below by taking, as examples, the
3 enlargement of a specific region, the reduction of a
4 specific region, the deletion of a specific region, the
5 display of a specific invisible region, and the selection
6 of a specific region.

7 3.1. Enlargement of specific region

8 In order to enlarge a specific region, there are used
9 a method for enlarging a font size, a method for opening up
10 a line spacing and the like, a method for increasing the
11 number of display elements to be displayed, and a combined
12 use thereof. In order to expand the area for the regions
13 without increasing the number of display elements to be
14 displayed, it is only necessary that the foregoing process-
15 ing for deciding the display content of the digest screen
16 be performed after a new font size and the like are set.
17 Here, a method for enlarging the specific region by
18 increasing the number of display elements will be described
19 below with reference to Fig. 19.

20 Target regions may be single or plural. In addition,
21 an extent of the enlargement (number of display elements to
22 be increased) may be designated by a user or may be prede-
23 termined. Fig. 19 is views showing respective states
24 before, in the middle of and after processing for changing
25 the sequence of the display elements arrayed in order of
26 the display priorities. Note that it is assumed that one
27 rectangle represents one display element and that the
28 sequence of the display elements is arrayed from the upper
29 left to the lower right. Moreover, the numbers on the
30 upper side, which are written in each rectangle, indicate a
31 region number and an order in the region ("x-y" denotes a
32 y-th display element in a region of a region number x), and
33 the symbol on the lower side indicates a display state.
34 Fig. 19(a) is a state of the sequence of the display

1 elements before the change. The symbol "circle" written in
2 the rectangle indicates that the concerned display element
3 is displayed on the digest screen at present, and the
4 symbol "cross" indicates that the display element is not
5 displayed. Here, it is considered that the region of the
6 region number 2 is enlarged. The "display marks" are added
7 from a head of the region of the region number 2 in
8 response to the extent of enlargement (number of display
9 element desired to be increased). This state is shown in
10 Fig. 19(b). The display mark is represented by a "blank
11 square." Furthermore, a result of executing the processing
12 of the flowchart shown in Fig. 18 to the end is shown in
13 Fig. 19(c). As understood from the views, enlargement of a
14 certain region will reduce another region (region of region
15 number 1) and make still another region (region of region
16 number 3) invisible.

17 3.2. Reduction of specific region

18 In order to reduce a specific region, there are used
19 a method for reducing a font size, a method for lessening a
20 line spacing and the like, a method for reducing the number
21 of display elements to be displayed, and a combined use
22 thereof. In order to reduce the area for the regions
23 without reducing the number of display elements to be
24 displayed, it is only necessary that the foregoing process-
25 ing for deciding the display content of the digest screen
26 be performed after a new font size and the like are set.
27 Here, a method for reducing the specific region by reducing
28 the number of display elements will be described below with
29 reference to Fig. 20.

30 Target regions may be single or plural. In addition,
31 an extent of the reduction (number of display elements to
32 be reduced) may be designated by a user or may be predeter-
33 mined. In Fig. 20, meanings of the figures, numbers and
34 symbols are the same as those described in Fig. 19. Fig.

1 20(a) shows a sequence of the display elements before the
2 change. Here, it is considered that the region of the
3 region number 1 is reduced. The "non-display marks" are
4 added from the last of the region of the region number 1 in
5 response to the extent of reduction (number of display
6 elements desired to be reduced). This state is shown in
7 Fig. 20(b). The non-display mark is represented by a
8 "solid square." Furthermore, a result of executing the
9 processing of the flowchart shown in Fig. 18 to the end is
10 shown in Fig. 20(c). As understood from Fig. 20, reduction
11 of a certain region will enlarge another region (region of
12 region number 2) and make a region that has been invisible
13 (none in Fig. 20) visible.

14 3.3. Deletion of specific region

15 Deletion of a specific region is to make a region
16 that is visible at present invisible and to make the region
17 a merged region merged with another visible region. In
18 order to delete the (single or plural) specific region (to
19 make the region invisible), it is only necessary to make
20 all of the display elements belonging to the region invis-
21 ble. To be more specific, it is only necessary to add the
22 "non-display marks" to all of the display elements belong-
23 ing to the concerned region in Step S80 of the flowchart
24 shown in Fig. 17.

25 3.4. Display of specific invisible region

26 Display of a specific invisible region is to make a
27 region that is invisible at present visible and newly
28 displayed. Thus, in most cases, the display area for the
29 other regions will be reduced. In order to display the
30 (single or plural) specific region (to make the region
31 visible), it is only necessary to display at least one of
32 the display elements belonging to the concerned region. To
33 be more specific, it is only necessary to add the "display
34 marks" to at least one of the head display elements

1 belonging to the concerned invisible region in Step S80 of
2 the flowchart shown in Fig. 17.

3 3.5. Selection of specific region

4 Selection of a specific region is to display only a
5 designated region and to make the other regions invisible.
6 In order to display the (single or plural) specific region
7 and not to display the other regions, it is only necessary
8 to display at least one of the display elements belonging
9 to a region desired to be displayed, and not to display any
10 display elements belonging to regions not desired to be
11 displayed. To be more specific, it is only necessary to
12 add the "display marks" to at least one of the head display
13 elements belonging to the region desired to be displayed,
14 and to add the "non-display marks" to all of the display
15 elements belonging to the region not desired to be
16 displayed in Step S80 of the flowchart shown in Fig. 17.

17 Note that, though the method for changing the display
18 content of the digest screen in response to the operation
19 of the user has been described in this embodiment, it is
20 needless to say that the display content of the detail
21 screen can also be changed by the same method.

22 Moreover, though the case of applying the present
23 invention to the browsing of the Web page has been
24 described in this embodiment, it is needless to say that
25 the application target of the present invention is not
26 limited to the browsing of the Web page. If control infor-
27 mation for setting a format of a document in a variety of
28 document editing systems such as a word processor, the
29 display priorities and the layout information for the
30 regions are obtained based on the control information, thus
31 making it possible to apply the present invention to the
32 browsing of the document in the variety of document editing
33 systems.

34 As described above, according to the present

1 invention, it can be certainly guaranteed that the
2 document, such as the Web page, the layout of which is
3 predetermined by the creator is transformed to fit within
4 the display required by the reader. Therefore, "no scroll
5 operations" are guaranteed in the Web browsing with a PC
6 and the like. Furthermore, in recent years, accesses from
7 household electric appliances such as a refrigerator and a
8 microwave oven to the Web have been made possible by
9 emergence of pervasive computing. That the document is
10 guaranteed to fit in a certain area is also effective when
11 browsing a Web page displayed on an Internet household
12 electric appliance having only a fixed and relatively small
13 display area. Moreover, the display elements of the
14 display content of the digest screen are selected based on
15 the display priorities of the display elements, and there-
16 fore, the limited display area can be effectively utilized
17 in terms of information acquisition. Furthermore, accesses
18 can also be made to the regions that are not displayed on
19 the digest screen at all as a result of selecting the
20 display elements. Moreover, according to the present
21 invention, the detail screen is displayed in a digest
22 format, and therefore, such browsing as approaching the
23 target portion by narrowing step by step the range from
24 which information is to be acquired can be performed while
25 confirming the whole structure of the page. Furthermore,
26 according to the present invention, the digest display and
27 the detail content display can be changed in response to
28 the operation of the user, and therefore, the browsing
29 environment comfortable for the user can be provided.

30 Although the preferred embodiments of the present
31 invention have been described in detail, it should be
32 understood that various changes, substitutions and altera-
33 tions can be made therein without departing from spirit and
34 scope of the inventions as defined by the appended claims.

1
2 Variations described for the present invention can be
3 realized in any combination desirable for each particular
4 application. Thus particular limitations, and/or embodi-
5 ment enhancements described herein, which may have particu-
6 lar advantages to the particular application need not be
7 used for all applications. Also, not all limitations need
8 be implemented in methods, systems and/or apparatus includ-
9 ing one or more concepts of the present invention.

10 The present invention can be realized in hardware,
11 software, or a combination of hardware and software. A
12 visualization tool according to the present invention can
13 be realized in a centralized fashion in one computer
14 system, or in a distributed fashion where different
15 elements are spread across several interconnected computer
16 systems. Any kind of computer system - or other apparatus
17 adapted for carrying out the methods and/or functions
18 described herein - is suitable. A typical combination of
19 hardware and software could be a general purpose computer
20 system with a computer program that, when being loaded and
21 executed, controls the computer system such that it carries
22 out the methods described herein. The present invention
23 can also be embedded in a computer program product, which
24 comprises all the features enabling the implementation of
25 the methods described herein, and which - when loaded in a
26 computer system - is able to carry out these methods.

27 Computer program means or computer program in the present
28 context include any expression, in any language, code or
29 notation, of a set of instructions intended to cause a
30 system having an information processing capability to
31 perform a particular function either directly or after
32 conversion to another language, code or notation, and/or

1 reproduction in a different material form.

2 Thus the invention includes an article of manufacture which
3 comprises a computer usable medium having computer readable
4 program code means embodied therein for causing a function
5 described above. The computer readable program code means
6 in the article of manufacture comprises computer readable
7 program code means for causing a computer to effect the
8 steps of a method of this invention. Similarly, the
9 present invention may be implemented as a computer program
10 product comprising a computer usable medium having computer
11 readable program code means embodied therein for causing a
12 function described above. The computer readable program
13 code means in the computer program product comprising
14 computer readable program code means for causing a computer
15 to effect one or more functions of this invention.
16 Furthermore, the present invention may be implemented as a
17 program storage device readable by machine, tangibly
18 embodying a program of instructions executable by the
19 machine to perform method steps for causing one or more
20 functions of this invention.

21 It is noted that the foregoing has outlined some of the
22 more pertinent objects and embodiments of the present
23 invention. This invention may be used for many applica-
24 tions. Thus, although the description is made for particu-
25 lar arrangements and methods, the intent and concept of the
26 invention is suitable and applicable to other arrangements
27 and applications. It will be clear to those skilled in the
28 art that modifications to the disclosed embodiments can be
29 effected without departing from the spirit and scope of the
30 invention. The described embodiments ought to be construed
31 to be merely illustrative of some of the more prominent
32 features and applications of the invention. Other

1 beneficial results can be realized by applying the
2 disclosed invention in a different manner or modifying the
3 invention in ways known to those familiar with the art.